Optimization of Long-Term Monitoring Programs

***David Becker**, Geologist, US Army Corps of Engineers Hazardous, Toxic, and Radioactive Waste Center of Expertise, 12565 W. Center Rd., Omaha, NE 68144*

Increasing amounts of money are being expended by the Department of Defense to monitor long-term (decades or longer) remedial actions such as ground water extraction systems, landfills, and natural attenuation sites. Efforts to optimize the monitoring programs will have large financial (and environmental) benefits. Optimization of monitoring considers the appropriateness of the frequency and location of sampling, and the analytical methods used.

Quarterly sampling is often done during site characterization to provide information on the (seasonal) fluctuations in concentrations. Frequent sampling is also often done after installation of the remedial action to verify the subsurface response to the remediation. Once a time-history of these frequent sampling events is available, the variability and trend in the data can be evaluated and the sampling frequency adjusted. A relatively objective and consistent approach to such an analysis, termed "Cost Effective Sampling," has been developed by workers at the Livermore National Laboratory and implemented into a software package called MAROS by the Air Force Center for Environmental Excellence. The more consistent the concentrations observed in a well, the less frequent the well needs to be sampled and vice versa. The software also implements sophisticated trend analysis to determine the trend in the data for wells, particularly useful for natural attenuation studies. The software develops recommendations for sampling frequency to be used as part of an overall evaluation.

The sampling network can be optimized qualitatively by careful evaluation of the locations in light of the project objectives using a Technical Project Planning/Data Quality Objective approach. Tools for quantitative analyses include various geostatistical approaches to predict concentrations or contours with and without data from specific wells. If similar values are predicted in a certain area with and without data from a given well, perhaps that well is not needed in the program. If the uncertainty in predicted values in a critical area is unacceptable, additional well(s) may be needed there.

Lastly, the number or type of chemical analyses required for samples from a site may be excessive (or inadequate). The broad suite of analyses done during characterization is often inappropriate for long-term monitoring programs. Carefully focused analytical work that looks only at the known contaminants that affect compliance and treatment is recommended. Alternatives for obtaining concentration data of adequate quality for the project may be available at lower cost than the current methods. Analytical methods currently used may not be adequate, on the other hand, for evaluating compliance with new or revised regulatory or risk-based standards. Alternative sampling methods may represent potential cost savings, such as the use of diffusion samplers and in-situ sensors. Current efforts in long-term monitoring optimization include a demonstration of the MAROS software and geostatistical methods. Applications of these tools are discussed.